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Quality Assurance (QA) acceptance plans are being used or developed by the vast majority of State Highway Agencies (SHAs) and most Federal transportation agencies. This has been an ongoing, evolutionary process that has taken place over several decades; it has led to much-improved acceptance plans, compared to those used in the past. This manual is a comprehensive guide that a highway agency can use when developing new or modifying existing acceptance plans and QA specifications. It provides necessary instruction and illustrative examples to lead the agency through the entire process of acceptance plan development, from initial investigation through implementation and ongoing monitoring efforts.

Major items include:

- Setting up the initial data collection/experimentation to determine typical parameters of current construction.
- Establishing the desired level of quality to be specified.
- Designing the actual acceptance plan, including selecting quality characteristics, statistical quality measure, buyer's and seller's risks, lot size, number of samples (sample size), specification and/or acceptance limits, and payment-adjustment provisions.
- Monitoring how the acceptance plan is performing.
- Making necessary adjustments.

The overall specification development and implementation process can be divided into three primary phases:

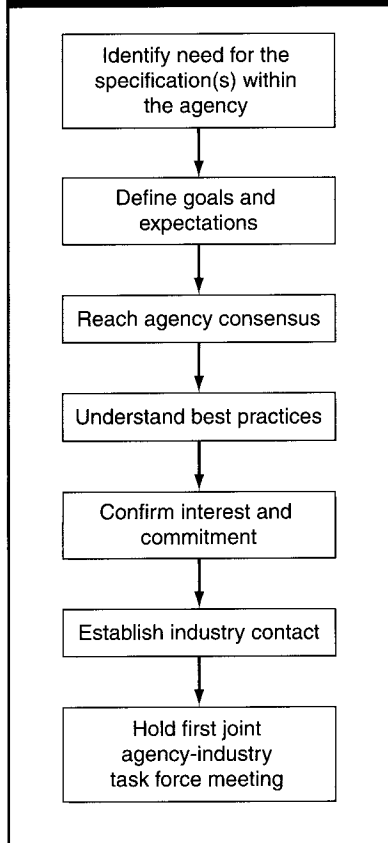
Phase I: Initiation and Planning.

Phase II: Specification Development.

Phase III: Implementation.

The steps in each of these phases can be represented in a flow-chart for each phase. The steps in each of the three phases are noted below, and discussed in detail in the manual.

Figure 1. Phase I: Initiation and Planning



The major steps in Phase I are identified in the flowchart in figure 1, and each of the seven major steps is elaborated in the manual.

The single most important factor in Phase I, and indeed throughout the process, is to obtain firm top management commitment to and support for developing and implementing the new QA specification. Without this support, success is unlikely.

The initial steps in Phase II set the stage for the actual

development of the QA specification procedures through:

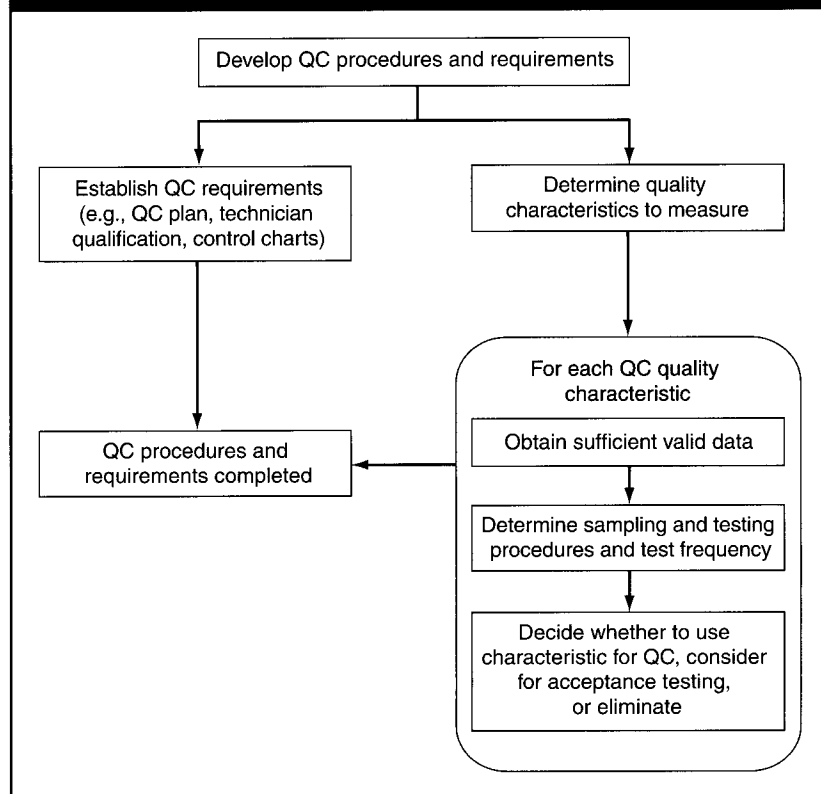
- Selecting the material or construction area in which to implement the new specification.
- Procuring outside expertise if required.
- Identifying current practices from the literature or by interviewing other agencies.
- Developing an initial draft general outline of the specification.

The next steps in Phase II deal with the development of quality control (QC) procedures. A very broad outline of the QC procedures development process is presented in figure 2.

The manual presents the steps in much greater detail, including an emphasis on the potential problems with using historical data and, if necessary, methods for obtaining new data. The manual also presents a discussion on the pros and cons of using operation-specific QC procedures as opposed to requiring generic, agencywide procedures.

As part of the acceptance procedures and requirements, one of the first decisions is to determine who will perform the acceptance tests. The answer will influence subsequent decisions and procedures in the acceptance plan.

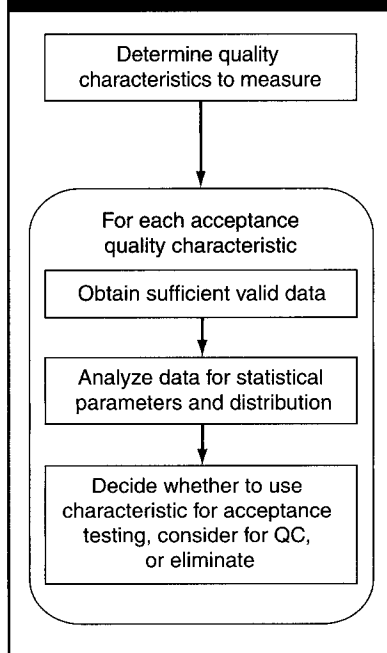
Figure 2. Quality Control Portion of Phase II: Specification Development



If the contractor or a third party acting on behalf of the contractor, such as a consultant, is required to do the acceptance testing, the agency must have a verification procedure to confirm or refute the acceptance test results. The manual includes extensive coverage of verification procedures and their associated risks to both owner and contractor. This is an extremely important issue, because staff reductions have led many agencies to begin to use contractor tests as part of the acceptance decision.

Figure 3 presents a macro-level overview of the steps involved in developing acceptance procedures for a new QA specification. Once again, the manual has extensive,

Figure 3. Acceptance Procedures Portion of Phase II: Specification Development



detailed coverage of each of these major topic areas.

The selection of the appropriate value to use for typical process standard deviation is particularly important and, if not done properly, can doom the specification to failure. Figure 3 presents the steps to determine what quality characteristics should be measured as part of the acceptance decision.

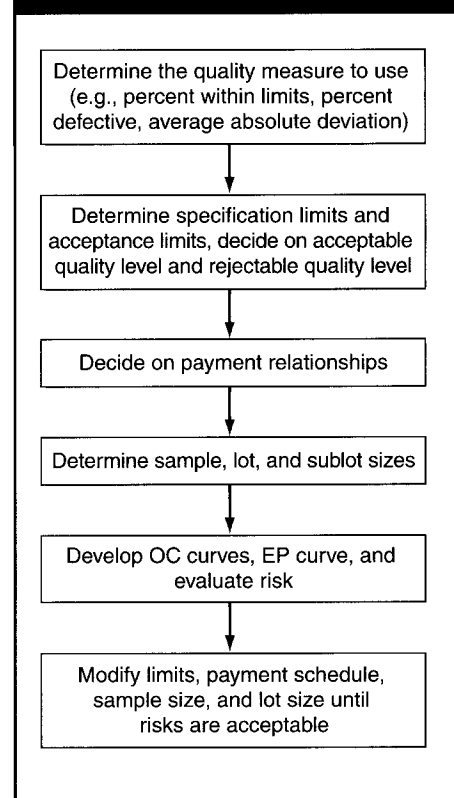
A decision is needed about which characteristics will be used to determine individual payment factors. If a characteristic will be used, the next step is to determine the appropriate quality measure. If the characteristic will not be used, it may be applied as a screening test on a pass or fail basis.

Figure 4 presents a macro-level overview of the steps involved in developing payment provisions for a new QA specification. The manual presents a detailed discussion of how to develop payment provisions along with procedures for evaluating the risks to both owner and contractor.

For pass or fail acceptance plans, the risks can be evaluated with an operating characteristics (OC) curve that plots probability of acceptance versus the actual quality level.

For an acceptance plan with payment adjustment provi-

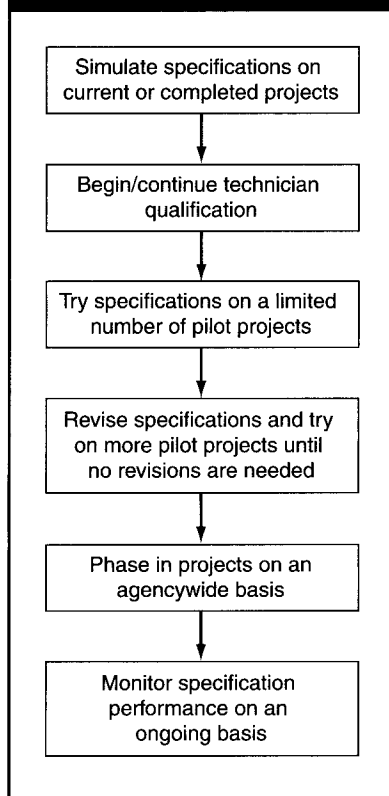
Figure 4. Payment Provision Portion of Phase II: Specification Development



sions, it is necessary to develop multiple OC curves, one each for various selected payment levels. Another important curve for evaluating payment risks is the expected payment (EP) curve. The EP is the average payment that the contractor can expect to receive for a population with a given level of quality.

OC and EP curves are discussed in great detail in the manual, and many examples are presented to explain how these curves can be developed. Determining the risks to both the owner and contractor and balancing these risks at an appropriate level are very important components of a successful specification.

Figure 5. Phase III:
Implementation



The general implementation steps are presented in figure 5. The manual presents more detailed implementation steps that SHAs have used successfully.

The new specification provisions can be simulated on current or recently completed projects to see what would have happened under the new specification. However, caution is urged when drawing conclusions based on simulated results, because contractors respond to how they are being paid and not to the simulated specification provisions.

It is very important to try the new specification on a limited number of pilot projects to determine how it works in the field. This allows the agency to fine-tune the specification under real-world conditions before implementing it on an agency-wide basis.

The manual contains numerous examples and case studies to provide guidance to transportation agencies seeking to implement new or to modify existing QA specifications.

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—Quality assurance, quality control, specifications, statistical specifications, QA, QC, payment adjustments, acceptance sampling plans.

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